
100 INTRODUCTION

Pollution Prevention Primer

“Environmental programs that focus on the end of the pipe or the top of the stack, on cleaning up after the damage is done, are no longer adequate. We need new policies, technologies, and processes that prevent or minimize pollution - that stop it from being created in the first place.”

President George Bush
October, 1990

100 INTRODUCTION

Pollution Prevention Primer provides an introduction to the subject of pollution prevention (P2), presents illustrative examples of pollution prevention practices, provides sources of pollution prevention information and profiles Internet search strategies for P2 information.

According to the United States Environmental Protection Agency (US EPA), pollution is created in billion pound quantities and annual pollution control costs are billions of dollars. More than 2.7 billion pounds of toxic air pollutants are emitted annually according to facility reports filed with US EPA pursuant to Section 313 of the Superfund Amendments and Reauthorization Act (SARA).¹ Table 100-1 summarizes other annual air pollutant releases by industry sector. US EPA reports that, on an annualized basis, total air pollution costs increased steadily since the passage of the US Clean Air Act in 1970. Stationary source control costs accounted for approximately 67-74 percent of this total. In 1990, US EPA estimated that by the year 2000 the annualized air pollution control costs will exceed \$44 billion. Stationary source costs would account for approximately 67 percent of this total.²

Historically, pollution management has included “end-of-the-pipe” pollution control equipment to treat pollution after it has been created. In 1990, the Pollution Prevention Act (Public Law 101-508) established a national policy that pollution should be prevented whenever possible. Hazardous wastes which are never created, do not require costly management and disposal. Hazardous air pollutants which are not produced, do not need to be controlled with expensive “end-of-the-pipe” treatment. Non-hazardous materials which are not wasted, are not buried at the landfill. Controlling crop pests with biological

100 INTRODUCTION

Pollution Prevention Primer

Table 100 - 1 Annual Air Pollutant Releases by Industry Sector (tons/year)

Industry Sector	CO	NO ₂	PM ₁₀	PT	SO ₂	VOC	TOTALS
Power Generation	366,208	5,986,757	140,760	464,542	13,827,511	57,384	20,843,162
Petroleum Refining	734,630	355,852	27,497	36,141	619,775	313,982	2,087,877
Iron and Steel	1,386,461	153,607	83,938	87,939	232,347	83,882	2,028,174
Pulp and Paper	566,883	358,675	35,030	111,210	493,313	127,809	1,692,920
Stone, Clay, and Concrete	105,059	340,639	192,962	662,233	308,534	34,337	1,643,764
Transportation	128,625	550,551	2,569	5,489	8,417	104,824	800,475
Organic Chemicals	112,410	187,400	14,596	16,053	176,115	180,350	686,924
Inorganic Chemicals	153,294	106,522	6,703	34,664	194,153	65,427	560,763
Nonferrous Metals	214,243	31,136	10,403	24,654	253,538	11,058	545,032
Lumber and Wood Production	122,061	38,042	20,456	64,650	9,401	55,983	310,593
Metal Mining	4,670	39,849	63,541	173,566	17,690	915	300,231
Nonmetal Mining	25,922	22,881	40,199	128,661	18,000	4,002	239,665
Plastic Resins and Synthetic Fibers	16,388	41,771	2,218	7,546	67,546	74,138	209,607
Metal Casting	116,538	11,911	10,995	20,973	6,513	19,031	185,961
Rubber and Misc. Plastics	2,200	9,955	2,618	5,182	21,720	132,945	174,620
Motor Vehicles, Bodies, Parts and Accessories	15,109	27,355	1,048	3,699	20,378	96,338	163,927
Textiles	8,177	34,523	2,028	9,479	43,050	27,768	125,025
Printing	8,755	3,542	405	1,198	1,684	103,018	118,602
Fabricated Metals	4,925	11,104	1,019	2,790	3,169	86,472	109,479
Pharmaceuticals	6,586	19,088	1,576	4,425	21,311	37,214	90,200
Furniture and Fixtures	2,754	1,872	2,502	4,827	1,538	67,604	81,097
Ship Building and Repair	105	862	638	943	3,051	3,967	9,566
Electronics and Computers	356	1,501	224	385	741	4,866	8,073
Dry Cleaning	102	184	3	27	155	7,441	7,912

Legend: Carbon Monoxide (CO), Nitrogen Dioxide (NO₂), Particulate Matter 10 microns or smaller diameter (PM₁₀), Particulate Matter Total (PT), Sulfur Dioxides (SO₂), Volatile Organic Compounds (VOC)

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organisms avoids the release of chemical pesticides into the environment. Preventing erosion stops sediments becoming water pollutants. These are simple, clear-cut examples of pollution prevention. Other pollution management measures may or may not be classified as pollution prevention depending upon the selected definition.

Lewis Carroll opined “When I use a word, it means just what I choose it to mean - neither more nor less”.³ The published literature describes many “green” practices which benefit the environment, which may not qualify as pollution prevention depending upon the operational definition of “pollution prevention”. For example, US EPA includes in-process recycling within pollution prevention, but excludes on-site and off-site recycling, energy recovery, treatment and disposal.

A recently published college text book, Pollution Prevention for Chemical Processes, includes on-site and off-site recycling as pollution prevention.⁴ The published literature on pollution prevention contains a varied lexicon including source reduction, waste reduction, cleaner production, toxic use reduction, and pollution management hierarchy – at times with conflicting definitions.

US EPA published Pollution Prevention 1991: Progress in Reducing Industrial Pollutants⁵ and Pollution Prevention 1997: A National Progress Report⁶ which summarize the progress made to define and implement pollution prevention. US EPA defines pollution prevention as “source reduction” and other practices that reduce or eliminate the creation of pollutants through:

- increased efficiency in the use of raw materials, energy, water, or other resources, and
- protection of natural resources by conservation.

Source reduction is defined as any practice which:

- reduces the amount of any hazardous substance, pollutant or contaminant entering any waste stream or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment, or disposal,
- reduces the hazards to public health and the environment associated with the release of such substances, pollutants, or contaminants.

100 INTRODUCTION

Pollution Prevention Primer

Source reduction includes:

- equipment or technology modifications,
- process or procedure modifications,
- reformulation or redesign of products,
- substitution of raw materials, and
- improvements in housekeeping, maintenance, training or inventory control.

According to US EPA, pollution prevention does not include:

- recycling (except, “in-process recycling”),
- energy recovery,
- treatment, or
- disposal.

It is important to note that various studies and reports may use different definitions and the Congressional reauthorization of the Federal Pollution Prevention Act may further modify the definition. In this report, “pollution prevention” and “source reduction” follow the US EPA definitions presented in Pollution Prevention 1997: A National Progress Report. Pollution management is a broader term than pollution prevention. It includes all practices which eliminate or minimize the generation of pollutants, or mitigate the environmental impacts of pollutants.

All pollution management options are not equal. The Federal Pollution Prevention Act of 1990 establishes the following pollution management hierarchy:

1. pollution should be prevented or reduced at the source whenever feasible,
2. pollution that can not be prevented should be recycled in an environmentally safe manner, whenever feasible,
3. pollution that cannot be prevented or recycled should be treated in an environmentally safe manner, whenever feasible, and
4. disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner.

In Pollution Prevention for Chemical Processes, the priority is listed as:

1. source reduction,
2. in-process recycling,
3. on-site recycling,
4. off-site recycling,
5. waste treatment to render the waste less hazardous,
6. secure disposal, and
7. direct release to the environment.

These authors include on-site and off-site recycling within pollution prevention; US EPA does not. Since environmentally beneficial actions are commonly called “green”, the array of pollution management options can be considered shades of green as depicted on the cover artwork for this report.

Pollution prevention is still an emerging field which draws on prior efforts to promote ecological stewardship, and minimize depletion of natural resources through sustainable development. For example, the State and Territorial Air Pollution Program Administrators (STAPPA) and the Association of Local Air Pollution Control Officials (ALAPCO) adopted Principles: Pollution Prevention and Sustainability which states:

“The state and local air pollution control officials believe that pollution prevention and sustainability are vital components of regulatory air programs. Activities which develop and promote pollution prevention and sustainability should be pursued whenever feasible. To this end, the associations believe that the following principles will guide state and local air agencies in identifying opportunities for and eliminating obstacles to the practice of pollution prevention and sustainability:

Pollution Prevention

Pollution prevention is a common sense approach to reducing emissions in order to protect public health and the environment. Consistent with the waste management hierarchy, source reduction should be the control option of first choice followed by in-process recycling or reuse, treatment and lastly add-on control. Pollution prevention practices should be held to a standard equivalent to

pollution control methods in regulatory actions, policies and procedures.

Pollution prevention should be integrated into air agencies' daily activities. Opportunities for pollution prevention exist in training, regulatory development, permitting, compliance assistance and enforcement.

Pollution prevention should be actively promoted to the regulated community, for example, in discussions with sources regarding future air pollution-emitting source projects, whether pre-permit meetings or compliance strategies for existing sources. Promotion can also be accomplished by providing relevant pollution prevention information, e.g. process modifications, substitute raw materials/products, cost benefits, reduction of regulatory burden, and by creating incentives and removing existing regulatory obstacles.

The review of air pollutant-emitting projects with potential multi-media impacts should be coordinated with the regulatory authority/ies responsible for those other media to reduce cross-media transfer of pollutants.

Cross-industry use of materials to reduce waste should be actively supported, including the development of a forum for providing information on available waste materials and potential waster material uses.

Emission reductions resulting from the implementation of pollution prevention projects should be credited, for the purpose of any state or local emission reduction program, in the same manner as emission reductions resulting from traditional control projects.

Sustainability

Protection of the environment is positively related to the social and economic health of a community.

Practices which meet current needs while ensuring long-term health and vitality of the community and environment should be promoted.

Environmental progress should be measured by meaningful environmental indicators.

100 INTRODUCTION

Pollution Prevention Primer

Agencies should facilitate collaborative stakeholder solutions by devoting resources to and establishing partnerships with the community to foster ownership.”⁷

101.1 HISTORY

The concept of pollution prevention can be traced back to 1977 when US EPA and the US Commerce Department held regional conferences to promote dialogue on this topic. In Pollution Prevention Pays, Michael Royston promoted pollution prevention as a way to see environmental protection and economic progress as complementary, not competing, goals.⁸ Each molecule of raw material which becomes a pollutant is lost product. Each dollar spent to landfill waste, treat air emissions or manage other waste is lost profit. Pollution which is never created does not need to be recycled, treated or disposed.

Pollution prevention became national policy with the enactment of the Pollution Prevention Act of 1990. Although pollution prevention is a universal concept which applies to all environmental media (i.e. air, water, soil, and biota) and to all US EPA statutes (e.g. Clean Air Act, Clean Water Act, and Resource Conservation and Recovery Act), the implementation of pollution prevention has varied from program to program due to unique statutory provisions as well as individual industrial process parameters. For example, due to the high cost of managing toxic chemicals, many early success stories involved hazardous waste. (See Hazardous Waste Survival Guide⁹ and reports published by the Department of Toxic Substances Control at <http://www.dtsc.ca.gov/txpollpr.htm>.)

As the benefits of pollution prevention have been documented by specific case hazardous waste studies, the implementation of pollution prevention has expanded to pollution sources in other media (e.g. air). Many companies have adopted corporate policies to “go beyond compliance” and exceed existing environmental requirements in enlightened self-interest. One early success story was US EPA’s 33/50 Program in which 1,300 companies, operating more than 6,000 facilities nationwide, agreed to establish goals to reduce chemical releases. The goal was reducing releases of 17 high priority chemicals by 33 percent by 1992 and 50 percent by 1995. The 1995 reduction goals of 50 percent were achieved a year ahead of schedule and eliminated 750 million pounds of pollution. Data from the US EPA Toxic Release Inventory program also document a steady decline in releases of toxic chemicals to the environment by

100 INTRODUCTION

Pollution Prevention Primer

the manufacturing sector. Since 1988, the first year of TRI reporting, releases of hazardous substances have decreased 46 percent.

Due to the costs of toxic waste management, many early case studies on pollution prevention involved hazardous waste. The efficacy of pollution prevention in mitigating air pollution was less widely publicized. Pollution Prevention Primer was funded in part by a Pollution Prevention Incentives for States (PPIS) Grant (#NP999358-01-1) from the United States Environmental Protection Agency. Key information on the air pollution benefits of pollution prevention has been extracted from the published literature and included in this report. Pollution Prevention Primer is not a compendium of all available studies. Instead, it summarizes the air pollution prevention information presented in the Sector Notebook published by US EPA's Office of Enforcement and Compliance Assurance in order to provide the reader with an introduction and overview of identified air pollution prevention options and document the demonstrated utility of preventing pollution as an air quality management practice. In addition, this report discusses the Internet as a vehicle for facility managers and air quality consultants to find useful pollution prevention information. Since the implementation of pollution prevention often involves industry or process specific procedures, this report includes Internet search strategies for air quality professionals information to use.

100 INTRODUCTION

Pollution Prevention Primer

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